Re: Switching +/−12V from 6/0V

Source: http://sci.tech−archive.net/Archive/sci.electronics.design/2007−07/msg02079.html

- *From*: James Arthur <dagmargoodboat@xxxxxxxxx>
- *Date*: Sun, 15 Jul 2007 09:01:03 −0700

On Jul 15, 5:16 am, George <gh424NO824S...@xxxxxxx> wrote:

> In article <4699BC43.9000...@xxxxxxxxxx>, nos...@xxxxxxxxxx
> says...
>
> > I'm really confused. Assuming what you say is right about
> > the PNP (that essentially all of the current is shunted
> > through to the collector), there's still the question of
> > total current through the 1K emitter resistor. It seems to
> > me that total voltage drop is not 6V, but 16V − from +6V to
> > −10V. So why isn't the total current 16ma using a 1K
> > resistor?
>
> > The base terminal of the PNP is sandwiched between the
> > collector and emitter. If the base is pinned to GND,
> > then the emitter, when forward biased, is one Veb above
> > the base potential which is 0.7V nominal. This makes the
> > voltage across the emitter resistor 6−0.7=5.3V. The
> > collector will be at one Vbe of the NPN above −10V,
> > making it 0.7+(−10)=−9.3V. Then the base collector
> > voltage of the PNP is 0−(−9.3)=9.3V, a good reverse bias
> > from N−base to P−collector which puts the transistor
> > into its active region. All of this can be confirmed by
> > measurement so you might try making some of those
> > sometime.
>
> Yes. I did that last night after my last post, and of
> course you are right. The emitter of the PNP does stay at
> .7V, which determines the current through the resistor.
> It's the transistor that drops the rest of the voltage.
>
> > The transistor loses current gain when driven into
> > saturation. Saturation is the operating condition of
> > both junctions forward biased. Most switching
> > transistors are designed for deep saturation at an Ic/Ib
> > ratio of 10 or less. This is the point where you have
> > least emitter to collector voltage drop and least power

> dissipation.

The problem is that the −10V is not a regulated supply.
It's just the negative lead of a capacitor which is charged
by a relatively weak charge pump in the MAX232. It is
actually −11.72V with the 555 Output low (no current flowing
anywhere). If I remove the coil load, so that only the
switching current is left, and then set the 555 Output high,
the current drawn by my version (47K PNP base resistor and
10K NPN base resistor) was 1.56ma, and the voltage rises to
−10.64V.

But if I use James' version using only the 1K PNP emitter
resistor and no base resistor, the switching current totals
4.1ma, and the voltage rises to −8.66V.

So, the more current I use to switch, the less I have left
to apply through the load itself. But I understand your
point about turning the NPN fully on. I guess I need to
think about how I would find the Goldilocks point that would
work for your average NPN transistor.

George,
The short version of all this is that the NPN transistor driving your relay (Q2) needs a certain amount of base current to do its 'thing,' to make sure it turns fully 'on' and drives your relay. We're all just trying to make sure it gets enough.

The amount needed varies with the gain of the NPN transistor. To switch 120mA, for example, a nice transistor might need a base current that is only 1% of that, or 1.2mA. So 1.6mA might even be enough, if you're lucky. A random junk−box transistor might need a base current as much as 1/10 its collector current to really pull all the way down. *We* over here don't know what your Q2 transistor is capable of−−only you know that.

However much current your particular Q2 needs, it's a tiny fraction compared to the amount of your MAX232 supply's current that goes to driving your relay. Therefore, Q2's 'switching current' isn't very important UNLESS you're leaving this thing on for a long time.

If you leave the circuit on all the time, then Q2 (and the relay) will drag on your +/−12v and prevent them from building up.

You're relying on the voltage built up in your filter capacitors to do all this work, so once you start it has to be done quickly−−push that button, then release it! If your MAX232 supply doesn't have enough energy to do that for as long as you'd like, then maybe you need some bigger capacitors.

> Maybe I should reverse everything and put the load below the transistor, so that the switching current also flows through the load, but I think that may complicate things more than it's worth. I don't know. I'll play with that.

I don't see how that would help. If it's already working, then heck, you're pretty close, right?

Best wishes,
James Arthur

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